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FOLK CLASSIFICATION AND CONSERVATION OF BAMBOO IN XISHUANGBANNA, YUNNAN, SOUTHWEST CHINA

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ABSTRACT.— Indigenous knowledge systems concerning the classification, identification, nomenclature and conservation of bamboo resources in ethnic areas may play an important role in sustainable development. Folk classification plays an important role in the plant identification systems of national minorities of China. Indigenous peoples classify plants based primarily on plants' economic uses, morphological characteristics, life forms, growth habitats, as well as sociocultural values, which are strongly rooted in biophysical and sociocultural environments. In addition, indigenous conservation practices that result from long-term interactions between indigenous peoples and natural resources provide reasonable and efficient production systems for the sustainable utilization of bamboo resources.

Key words: Folk classification, conservation, bamboo, Xishuangbanna, China

RESUMEN.–Los sistemas de conocimiento indígenas referente a la clasificación, identificación, nomenclatura y conservación de recursos de bambú en areas étnicas podría ser un factor importante en cuanto al desarollo sostenible. La clasificación usada por los campesinos toma una posición significante en los sistemas de identificación de plantas de las minorías nacionales de la China. Los indígenas clasifican plantas basándose primordialmente en su uso económico, sus características morfológicas, sus formas de vida, sus hábitats de crecimiento, además de sus valores socioculturales que estan fuertemente radicados en ambientes biofísicos y socioculturales. En adición, los recursos naturales indígenas proveen sistemas de producción que son razonables y eficientes para la utilización sostenible de los recursos del bambú.

RÉSUMÉ.–Les systèmes de connaissance indigène concernant la classification, l'identification, la nomenclature et la protection des ressources en bambou dans les régions ethniques ont un rôle important à jouer dans le maintien du développement. La classification populaire est une dimension importante du système d'identification des plantes chez les minorités nationales de la Chine. Les autochtones classifient les plantes principalement en su basant sur leurs utilisations commerciales, leurs caractéristiques morphologiques, leurs formes de vie, leurs habitats ainsi que sur des valeurs socioculturelles fortement enracinées dans les environnements et socioculturels. En outre, les pratiques indigènes en matière de protection assurent d'une façon raisonnable et efficace le maintien de l'utilisation des ressources en bambou qui proviennent ellesmême d'une interaction à long terme entre les peuples et la nature.

INTRODUCTION

Bamboo, together with several groups of herbaceous bambusoid grass, is classified by taxonomists as the subfamily Bambusoideae within the grass family Gramineae (Poaceae). As ornamental plants and sources of raw material for papermaking, textiles, basketry, matting, rope, house construction, furniture, bridges, and fishing equipment, bamboo provides a greater diversity of uses in Asia than any other group of closely related plants (McClure 1956).

Bamboo is an important non-timber forest product (NTFP) with a high commercial value. As an important resource, bamboo has been exploited and utilized by various institutions. Heightened attention has resulted from greater recognition of the need for sustainable use of natural resources, and the need to maintain biodiversity while pursuing economic development (Williams et al. 1991). However, increasing demand for the world's bamboo resources is related to a series of threats to bamboo diversity, and has led to the extinction of a number of bamboo genetic resources. Over-exploitation and habitat destruction of bamboo genetic resources increases these threats. For example, in the Indian Himalayan region, twelve species of bamboo have been marked as rare and endangered due to biotic pressure coupled with biological phenomena such as periodic flowering, poor seed setting and indiscriminate exploitation (Biswas et al. 1997). *Qiongzhuea tumidinoda* in Yunnan is one bamboo species known for its beautiful culms (stems) and has been exported to south Asia since as early as the ancient Han Dynasty (1,200 years ago). The shoots of this bamboo species are exported to Japan and other countries every year. Due to the over-exploitation of this bamboo for various ornamental, construction, and handicraft purposes, it is now one of two species of Bambusoideae on the list of Chinese Preserved Plants.

In contrast, indigenous communities such as the Hani, Dai and Jinuo in Yunnan, southwest China have been using traditional methods and strategies of bamboo exploitation that lead to the sustainable utilization and development of bamboo resources. It is therefore important to study the indigenous knowledge systems that relate to the classification, identification, utilization, management and conservation of bamboo resources.

OBJECTIVES

The objective of this paper is to survey, describe and evaluate bamboo species that are classified and conserved by indigenous communities in Xishuangbanna, Yunnan Province, China utilizing ethnobotanical methods, and to propose approaches for the sustainable management and conservation of bamboo resources by incorporating relevant indigenous knowledge. Three objectives were therefore identified in this study: (1) to survey and collect indigenous knowledge on classification, nomenclature, and conservation of bamboo resources in indigenous communities; (2) to describe and discuss the folk classification system of bamboo; and (3) to determine and describe the conservation practices of bamboo resources by indigenous communities in Xishuangbanna, Yunnan.

STUDY AREA

The study area is located in Xishuangbanna, Yunnan Province in southwest China. Yunnan Province is an inland and remote province in southwest China, located within 21°8' - 29°15' N and 97°32' - 106°12' E. Xishuangbanna is located in the southwest of Yunnan Province, bordering Myanmar and Laos (Figure 1).

Geographically, Xishuangbanna is located at the southeast end of the Hengduan mountains– the eastern appendages of the Himalayas. Xishuangbanna lies within 21°10' - 22°40' N, and 99°55' - 101°50' E with a total area of 1,922,300 hectares, of which 94% consists of mountainous and hilly terrain, with river valleys making up the remaining area. The elevation is low in the south and high in the north; from the south to the north the elevation rises from 420 m to 2,800 m above sea level. The annual rainfall ranges from 1,138 to 2,431 mm, the annual mean temperature varies from 15°C in winter to 22°the C in the summer, and the annual mean relative humidity is between 70 - 80%. The unique landforms and complex physical conditions make Xishuangbanna a diverse ecological environment with various ecosystems. Tropical forests account for 33.8% of the total area cover. The biological resources are so plentiful that Xishuangbanna is known as "the kingdom of wild flora and fauna." Xishuangbanna is home to the vast majority of

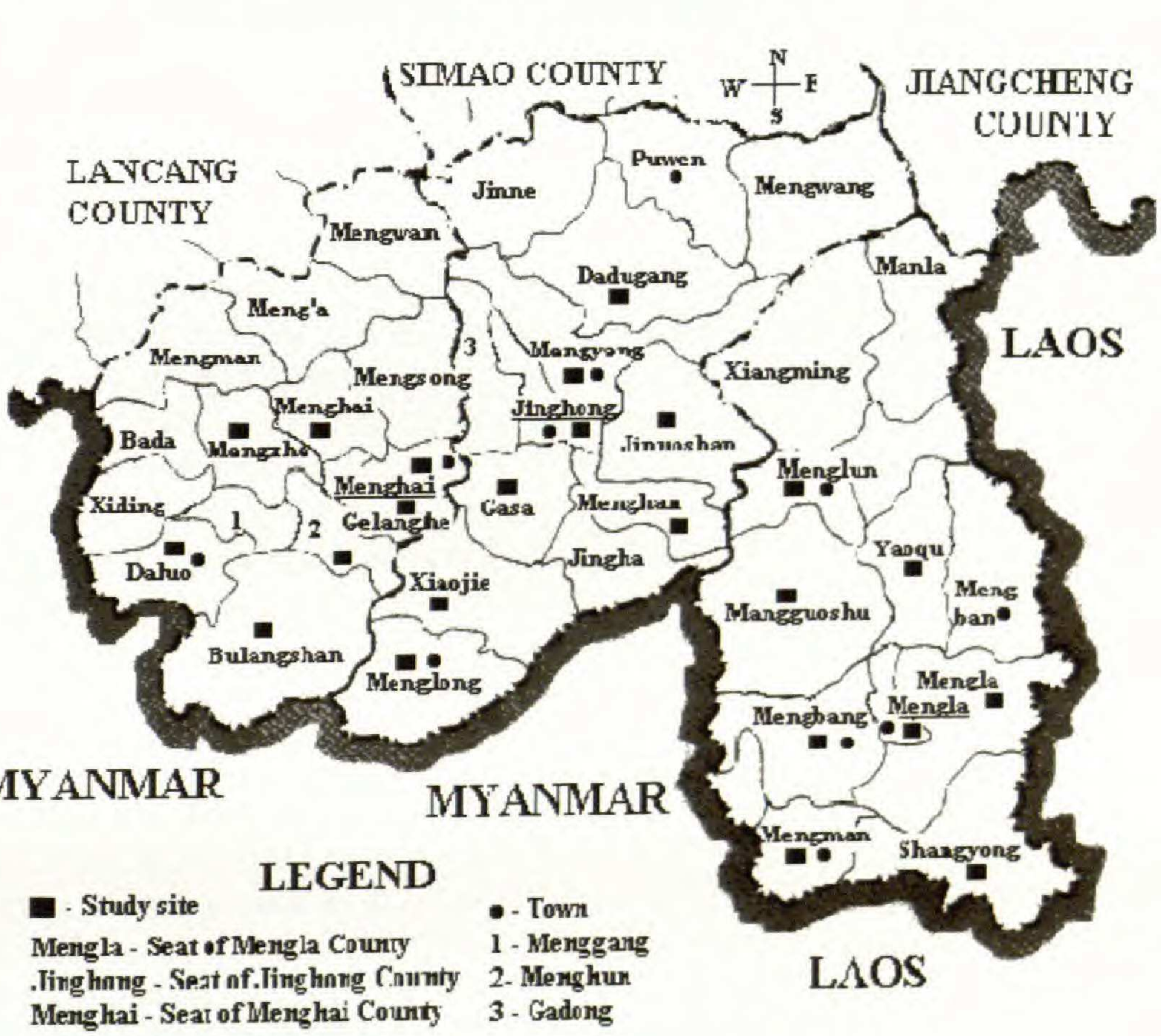

FIGURE 1.– Map of the study area and research sites in Xishuangbanna, Yunnan Province, China

plants and animal species found in China. A total of 4669 higher plant species, subspecies or varieties belonging to 1697 genera of 282 families have been recorded in Xishuangbanna (Li et al. 1996). Nearly one sixth of the total species of China (30,000 species) can be found here, although it constitutes only one five hundredth of China's total land area.

Xishuangbanna is a multi ethnic area. It is comprised of 13 different ethnic groups which include Dai, Hani (also called Aini), Lahu, Bulang, Yi, Jinuo, Yao, Wa, Hui, Bai, Zhuang, Miao, Buyi, and other unidentified ethnic groups (e.g., Kemo, Kemie, and Kongge). Each ethnic group has its own language and folk knowledge, especially concerning the utilization, management, and conservation of natural resources. Bamboo is a useful plant and its cultivation is widespread, being used by all of the ethnic communities.

METHODOLOGY

Literature search.– The first stage in this study included a background search for information, specimens, and documentation related to the taxonomy of bamboo and indigenous knowledge systems of folk classification, identification and conservation of bamboo resources.

Site visits and interviews.– The second stage involved visiting sites and interviewing local people. In this study, the sites were selected based on three criteria: species, cultural diversity, and economic diversity. The research team visited twenty three study sites (Figure 1) were visited. More than 100 local people were interviewed concerning the distribution, habit, ecological condition, and regeneration of bamboo, as well as indigenous knowledge systems of folk classification, utilization, management and conservation of bamboo. Interviews with local people were conducted in three phases. In the first phase the local leaders and experienced persons were asked to recall important and/or memorable bamboo species in the study area. This phase was usually done at night. The interviewers used a previously prepared questionnaire with simple and clear questions (Table 1, part I). The second set of interviews involved general and specific questions that were related to the species mentioned in the first interview, and were used to serve as a guide in the field survey (Table 1, Part II). The third and final phase of interview stage involved a group interview in which respected members of the local community were asked to assess the nature of use and confirm the local names of bamboo species. The study included community elders as they have a historical perspective of the use of the bamboo resources.

Field observation and specimen collection.– Information on culm habit (strictly erect, pendulous or climbing), rhizome system (sympodial or monopodial), culm characteristics (height, diameter, branching, node, internode, etc.), culm sheaths (the fifth culm sheath was characterized based on the general appearance, size, texture and shape of sheath and their blades), leaves, and inflorescence (by presentation) was recorded. This field investigation included some accurate and detailed information, such as local names and their meaning, diagnostic characteristics, distribution, special utilization and conservation practice, and so on. In addition, market data were recorded in detail.

TABLE 1.– Bamboo interview instrument

Part I: General Investigation

Village: _____ Name of Farmer:

Collector(s): _____ Date: _____ Collection No.:

How many bamboo species are in your area? (Lists of local names):

1) Wild: _____

2) Cultivation: _____

Which bamboo do you like to cultivate? (Lists of local names):

_____

Where is the bamboo cultivated?: 1. home garden, 2. swidden field, 3. bamboo garden,

4. bank of channel, 5. forest-land, 6. Other _____

How much bamboo is harvested in one year?: Culms_____; Shoots:____ kg

How do you propagate bamboo?: 1. rooted cutting, 2. rhizome-offset, 3. culm cutting,

4. branch cutting, 5. seedling, 6. Other _____

Remarks: _____

_____

Part II. Specific Bamboo Species Investigation

Vernacular Name_____ ; Meaning _____

Important Characteristics (for identification): _____

Habitat: 1. cultivated, 2. disturbed, 3. partly disturbed, 4. other _____

Rhizome Types: 1. sympodial (dense clump), 2. monopodial (scattered clump)

Culm Habit: 1. erect, 2. arching over 3. decumbent, 4. scandent / climbing

Culm: 1. height ____m, 2. diameter ____cm, 3. thickness ____cm, 4. internode length

____cm, 5. surface: a) glaucous, b) glabrous, c) hairy, d) spinules present, e) striate,

f) color, g) other _____

Number of Branches: 1. single, 2. two, 3. three,

4. multi-branching: a) with main branch, b) without main branch

Culm Sheath: 1.characteristics: a) persistent, b) caducous, c) deciduous d) other

2. texture: a) soft, b) hard, c) leathery, d) others _____

3. surface: a) glaucous, b) glabrous, c) hairy, d) spinules present and e) other _____

Sheath blade: 1. erect 2. horizontal 3. reflexed, 4. hairy _____

Leaf: 1. large, 2. medium, 3. small, 4. other (specify) _____

Uses: 1. shoot: a) sweet, b) bitter, c) fresh use, d) dry use, e) pickled shoot, f) sour shoot

2. building material: a) pillar, b) scaffolding, c) framework, d) wall or ceilings

3. weaving materials; 4. furniture; 5. agriculture tools, 6. ornamental, 7. medicine

8. music instrument, 9. folk belief, 10. other (specify) _____

Wood Quality Parameters: 1. strength: a) hard, b) soft, c) durable

2. elasticity: a) very good, b) good, c) poor, d) other (specify) _____

3. smoothness: a) smooth, b) rough, c) other _____

Market Potential: 1. very good, 3. good, 3. poor, 4. other _____

Remarks: _____

_____

Identification and examination of herbarium specimens.– Consultation and examination of herbarium materials of related bamboo species was conducted in various institutions and universities. The collected specimens were identified and examined based on folk classification and scientific taxonomic knowledge. An ethnobotanical inventory was carried out based on biosystematics and ethnobotany. The inventory included scientific names, vernacular names, uses, distribution, and voucher specimens, although the inventory is not included due to the space limitations of the paper.

FOLK CLASSIFICATION

It is common knowledge that when plants are utilized for any purpose, understanding their value and characteristics are very important. Folk classification has a very important role in the identification system of Yunnan's and China's minorities. In China, especially in the indigenous communities of Xishuangbanna, local people classify plants mainly based on local language, production practices, social customs, legends, economic utilization, morphological characteristics, and growth habits, which have very important economic and functional values (Wang and Hsueh 1990). Different ethnic communities may have different folk classification systems. For example, Hani people in Mengsong of Xishuangbanna use and recognize bamboo through traditional knowledge of bamboo habit, utilization and other characteristics. They understand the differences between erect and climbing bamboo. Erect bamboo is called ***Aq*** or ***Al*** (in Hani) as the first name, and climbing bamboo is called ***Haq***. Second, they give bamboo lower taxonomic rankings according to the morphological or utilization characteristics (Tables 2 and 3).

Dai folk classifications systems are more integrated and closer to Western science than the Hani system. For example, Dai people assign small-leaved *Dendrocalamus* spp. to the group ***Maisang***, glaucous-culmed ones to the group ***Maihe***, and group culmed striate *Gigantochloa* spp. to ***Maishua*** (Table 4). The Dai folk classification system of bamboo does not correspond exactly to Linnaeus' taxonomic system, but it is similar in the concepts of group, species and subspecies.

In comparison with scientific taxonomy, indigenous folk classification offers some important benefits. (1) Folk classification is often faster to use and simpler than the modern scientific taxonomy. Folk classification names a kind of bamboo

TABLE 2.– Folk classification of bamboo as related to use in Hani Communities of Mengsong, Xishuangbanna

Hani Name	Meanings	Bamboo Species
aqqyul	***qyul*** 'sweet', bamboo shoot is sweet	*Dendrocalamus hamiltonii*
alhaq	***haq*** 'bitter', bamboo shoot is bitter	Indosasa singulispicula
almal	***mal*** 'flute film', bamboo film used to make the bamboo flute	Phyllostachys mannii
aqmiov	***miov*** 'not seen'; it is said "a pig that eats this bamboo seed will die"	Cephalostachyum fuchsianum

TABLE 3.– Folk cassification of bamboo according to habit and character in Hani Communities of Mengsong, Xishuangbanna

Hani Name	Meanings	Botanical Name
aqpeel	***peel*** 'big': big bamboo	*Dendrocalamus giganteus*
aqbaol	***baol*** 'wild': wild bamboo	*Dendrocalamus* sp.
alnml	***lnml*** 'thorn': internodes have thorns, and young shoots are good, abundant and dense	*Chimonocalamus fimbriatus* var. *ligulatus*
alquq	***quq*** 'thorn': but the younger shoots grow sparsely	*Chimonobambusa yunnanensis* var. *glabra*
aqjul	***jul*** 'smooth': culm is smooth	*Dendrocalamus strictus*
aqljul	***ljul***: similar to ***jul***, but even smoother	*Fargesia* sp.
aqxao-aqlan	***xao*** 'stripe', ***lan*** 'grayish white': culm gray with stripe	*Gigantochloa nigrociliata*
aqxao-xeel	***xeel*** 'green': so culm green with stripe	*Dendrocalamus membranaceus* var. *striatus*
aqyeq	***yeq*** 'black': culm is black	*Dendrocalamus* sp.
haqgeeq(-mal)	***haq*** 'climbing', ***geeq*** 'wild': climbing bamboo with wide culm-node	*Melocalamus compactiflorus*
haggeq-aqzaoq	***aqzaoq*** 'narrow': climbing bamboo with narrow culm-node	*Melocalamus* sp. 1
haggeq-aqxeel	***aqxeel*** 'thin': climbing bamboo with thin culm-wall	*Melocalamus* sp. 2
Jeiqnav	bamboo shoot very dense and abundant	*Indosasa* sp.

based on direct observation and evaluative characteristics, whereas scientific classification often requires herbarium study. (2) The local name or folk classification can facilitate communication between local people and researchers. However, skilled ethnobotanists must know and understand the local names of related species, then use the names and morphological characteristics to match the folk taxon with a scientific name or names. (3) Folk names are often related to use, and to characteristics and first-hand experience. Folk classification can offer important clues to the exploitation of the resource by local people, and thus is useful for commercial and government planning, and to scientific researchers.

However, folk classification, in comparison with scientific classification, has a number of disadvantages. (1) Heterogeneity: similar bamboo species within a village or other villages may be referred to by different name (Table 5), or different bamboo species may be given a similar local name. (2) Limitation: bamboo folk classification, like all other forms of indigenous systems, has its limitations. Hani people divide bamboo into only two types: erect bamboo (*Aq* or *Al*) and climbing bamboo (***Haqgeeq***).

TABLE 4.– Group and individual names for bamboo species in a Dai Community

Group name	Individual Name	Bamboo Species
Maisang:*Dendrocalamus* spp. with smaller leaves	***Maisang***	*Dendrocalamus membranaceus*
	Maisanghe	*D. membranaceus f. fimbriligulatus*
	Maisanglai	*D. membranaceus f. striatus*
	Maisanghuan	*D. membranaceus f. crinitus*
	Maisanghai	*D. membranaceus f. bigemmatus*
	Maisangkou	*D. membranaceus f. pilosus*
	Maisangdaben	*D. membranaceus* var. *sulcatus*
	Maisanglan	*D. barbatus*
	Maisangbo	*D. albostriatus*
Maihe: *Dendrocalamus* spp. with glaucous or white haired culm.	***Maihegai***	*D. semiscandens*
	Maihelao	*D. brandisii*
	Maihelan	*D. brandisii f. hispiatus*
	Maihezhang	*D. hookeri*
	Maihelong	*D. hamiltonii* var. *serratus*
	Maihegaihao	*D. longiligulatus*
	Maihemen	*D. longiligulatus f. lacanus*
	Maihelaiqiu	*D. longiligulatus f. striatus*
Maishua: *Gigantochloa* spp., with striated culm	***Maishua***	*Gigantochloa nigrociliata*
	Maiheshua	*G. felix*
	Maishuahei	G. sp. 1
	Maishuanai	G. sp. 2

INDIGENOUS PROPAGATION PRACTICES

Cultivation of a number of bamboo species around houses, villages and fields is a tradition of many ethnic communities and individuals in Xishuangbanna. For example, the Hani families in Mengsong cultivate a large number of bamboos (Table 6, based on semi-structured interviews and sample questionnaire interviews). A local community usually prefers to plant bamboo and rattan together, because the bamboo supports the rattan. In recent years, ginger and tobacco have been intercropped with younger bamboo clumps for economic and ecological reasons.

Rooting of culm cuttings is traditionally used in propagating bamboo by ethnic communities of Xishuangbanna. However, Hani people in Mengsong commonly plant branch-cuttings of ***Aqqyul*** (*Dendrocalamus hamiltonii*) in swidden fields. They believe that this method results in slowing the growth of bamboo.

Bamboo plays an important role in the local economy. Table 7 shows economic statistics from the Menglong town government. Although these figures are not exact, they show the role of bamboo in indigenous communities. Other case studies have shown that bamboo and rattan together occupy the seventh position in the local economy based on semi-structured questionnaires (Wang 1998).

TABLE 5.– Names with translation, of *Indosasa singulispicula* in different ethnic communities.

Ethnic communities	Local Name	Meanings
Dai Commmunity	***Maihong***	***Mai*** 'bamboo', ***hong*** 'bitter'
Hani Community	***Alhaq***	***Al*** 'erect bamboo', ***haq*** 'bitter'
Aini Community	***Rahaq***	***Ra*** 'erect bamboo', ***haq*** 'bitter'
Yao Community	***Laoying-zhang***	***Lao*** 'bamboo', ***ying*** 'bitter', ***zhang*** 'small'
Kucong Community	***Wakada***	***Wa*** 'bamboo', ***ka*** 'bitter', ***da*** 'shoot'

TABLE 6.– The status of cultivation and utilization of bamboo in Mengsong Villages

Item sample	No. of groves per household	No. of species	No. of shoots/ groves/year	No. of culms used per household
1	20	6	17.5	75
2	9	3	-	-
3	12	4	10	75
4	30	4	20	30
5	20	4	20	50
6	20	5	25	100
7	17	5	5	25
8	25	4	12	60
9	25	4	10	75
10	10	6	10	50
11	10	4	15	50
12	150	6	20	100
13	35	3	3	100
14	40	50	15	100
15	10	5	10	50
16	50	4	20	100
17	80	6	20	50
18	7	3	8	35
19	100	5	10	50
20	15	5	20	40
21	10	5	10	35
22	18	5	10	20
23	8	4	10	45
24	9	5	8	50
25	6	2	10	20
26	50	5	15	50
27	20	5	18	100
28	30	5	30	100
29	100	4	25	50
30	45	6	10	225
31	10	3	10	20
Total	991	140	426.5	1993
Average	32	4.5	14.22	64.33

TABLE 7.– Statistics of bamboo production in Mengsong, Xishuangbanna

Year	No. of cut or harvested culms Large	Small	Dry shoots (kg)	No. of weaving products*	Total value (US$)
1985	71100	-	3792	648	53,192
1986	12920	-	3896	940	12,534
1987	13997	7550	3832	2035	18,130
1988	12920	7550	3896	970	15,182

* Note: Weaving products include a few rattan materials

CONSERVATION

Practices.– All ethnic communities in Xishuangbanna have a long tradition of planting, managing and conserving bamboo. Bamboo forests are classified into three types of property: national, community and family/individual bamboo forests. These are managed or protected by different agencies or individuals.

Based on the social, economic, cultural, and ecological surveys and studies, some efficient and reasonable management and conservation of bamboo genetic resources in Xishuangbanna are described below.

In-situ conservation.– Indigenous knowledge systems and national policies of China warrant the conservation of genetic resources of bamboo in China. Especially in minority areas, *in situ* conservation, through cultivation of bamboo plants among or along the village boundaries through establishment of bamboo gardens, and the maintenance of National Nature Reserves, are efficient methods of protecting and conserving the bamboo germplasm of China.

Community based conservation. Many bamboo species, naturally distributed and cultivated, are protected in community bamboo forests. These community forests are especially maintained by local religious or belief groups. ***Sangpabawa*** (the community protected forest in Hani communities), ***Nong Man*** or ***Nong Meng*** (community Holy Hills), ***Nong Ban*** (village Holy Hills in Dai ethnic groups), ***Ba Hao*** and ***Lao Ben*** (Graveyard forests, in Dai and Hani communities, respectively), ***Gai Mei San Ha*** (Water-source forests in Hani communities) are protected and well managed. There are also many Buddhist communities and Buddhist temples in Xishuangbanna that conserve bamboo resources. There are four requirements for establishing a temple (***Wa*** in Dai language) which are as follows: (a) a statue of Sakyamuni (Pagodama-Zhao, in Dai language), the founder of Buddhism, (b) a pagoda in which Sakyamuni's ashes can be preserved, (c) at least five monks, and (d) the presence of some specified "temple-yard plants" (Pei 1991). Based on these requirements, many plants have been cultivated inside the temple, some of which include bamboo species such as *Thyrsostachys siamensis*, *Bambusa sinospinosa*, *Dendrocalamus hamiltonii*, and *Phyllostachys mannii*.

Family/individual based conservation. Home gardens, bamboo gardens (***Aqpeya***, in Hani community), agroforestry practices, and swidden farming form a series of traditional systems for sustainable cultivation, management and conservation of bamboo resources. The bamboo clumps or forests belonging to every family are cut, managed, and conserved by the families. For example, the Dai people plant the multi-purpose bamboo species in the home garden or near the village,

and Hani people establish a bamboo garden (***Aqpeya***) or cultivate bamboo in the swidden system, and in ***Sangpabawa***.

In general, more valuable bamboo species, such as *Dendrocalamus giganteus, D. hamiltonii, D. barbatus, D. membranaceus, D. calostachyus, Indosasa singulispicula, Bambusa lapidea, Cephalostachyum pergracile,* and *Schizostachyum funghomii* are planted inside home gardens or bamboo gardens.

Swidden cultivation is practiced among all the mountain ethnic groups in the eastern Himalayan region. In Mengsong of Xishuangbanna, the Hani people have developed an agroforestry system. They cultivate bamboo in the swidden lands, and plant rattan using the bamboo clumps as support for the climbing rattan. Tobacco is intercropped among the bamboo clumps. The bamboo branch or culm is sometimes burned and the ash is used to fertilize tobacco. In other cases, bamboo is intercropped with maize, beans, vegetables and other crops in the agroforestry system of the Hani community of Mengsong. Short, medium and long-term income is obtained from the bamboo. The sloping swidden land is used for long-term agriculture products, thanks to the conservation of soil by the well developed roots-system of bamboo plants.

State conservation. National bamboo forests are grown and maintained in China's National Nature Reserves. These bamboo species, along with other conserved plants in the reserves, are protected from commercial activities.

Ex situ conservation.– Ethnobotanical information is considered useful to add to the information on collected plants in living-plant collections, seed-germplasm collections and herbarium collections. Data on vernacular (local) name of plants, indigenous uses of plants, ecological knowledge of plants, and local management practices of those plants are valuable. New information, which is generated from ethnobotanical expeditions, helps botanical gardens make plant lists for new collections (Pei 1994). In Yunnan and Xishuangbanna, the bamboo germplasm collection in the Xishuangbanna Tropical Botanic Garden is important for ex situ conservation of bamboo resources. According to this study, more than 100 species, varieties, and forms of bamboo belonging to 19 genera have been planted in this garden and are growing well.

Control of over-harvesting.– There are 91,800 ha of natural bamboo forests, or bamboo/tree mixed forests in Xishuangbanna that belong to the state, communities, and individuals (Wang and Hsueh 1992). These areas are managed and harvested (bamboo shoots and bamboo culms) to protect the watersheds and conserve bamboo gene pools. The traditional harvesting of bamboo shoots and culms from forest lands has been sustainable when these lands have been harvested for villager's home consumption, rather than for commercial purposes.

CONSERVATION ISSUES

Destruction of environment and natural habitat.– Destruction of the environment and natural habitat due to logging, shifting cultivation, and other land uses have led to the extinction of some bamboo species and depletion of bamboo forest resources.

In some parts of Xishuangbanna, shifting cultivation has primarily destroyed bamboo resources as a result of unscrupulous cutting of large areas of bamboo forest for agricultural land use (Wang and Hsueh 1992).

One conspicuous case of habitat destruction was the establishment of rubber plantations on more than 43% of Jinghong farms, which were previously natural bamboo forest or mixed bamboo/tree forests. Moreover, large bamboo areas have been converted to plantations of economic crops and plants, such as banana, coffee, tea, and fruit trees.

Over-exploitation and limited distribution.– In many cases, over-exploitation and lack of artificial propagation are threatening bamboo resources. For example, it is well known that the raw materials for papermaking, production of chopsticks and woven products in Xishuangbanna are supported only by the natural bamboo forests (Wang et al. 1993)

On the other hand, unreasonable and inefficient exploitation and utilization of bamboo resources have also led to the degeneration of natural bamboo stands. New emigrant workers who work for national farms or are employed by local people from Sichuan, Hunan and other provinces gather bamboo culms and shoots mostly from the natural bamboo forests. Insufficient knowledge on how to use and manage bamboo resources can lead to inefficient utilization and overexploitation. Rhizome cutting which deviates from the traditional methods of propagation, and culm cutting and shoot gathering by choosing only the large culms and stocky shoots, lead to the deterioration of bamboo species resources.

CONCLUSION

Indigenous knowledge concerning the identification, classification, nomenclature and conservation of bamboo plants have several important roles that are reviewed below.

Vernacular and scientific names.– The local plant nomenclature existed previously in oral tradition (Kelly and Dickinson 1985). Vernacular names of plant species are very important to plant resource inventories. They are based on indigenous people's productive practice, social customs, legends, and economic utilization. Habit and morphology of plants also have economic and functional significance. It should be noted, however, that sometimes those vernacular or local names are not considered very important for identifying bamboo because they are often not reliable. Therefore, great caution is required in the interpretation of vernacular names (Dransfield and Widjaja 1995).

Validity of folk classification.– There is a need to recognize the value and scientific validity of folk classification. Recognition and methods of use of plant resources by indigenous people are similar to those of the scientific world. For example, indigenous peoples classify plants, usually using morphological characteristics and physiological attributes, with consideration of their growing and reproductive habits.

Deep knowledge and utilization of indigenous knowledge.– It is important to recognize

that there is more detailed knowledge contained in some folk classification systems as compared to scientific classification. For example, local soil taxonomy of African farmers is based on soil characteristics as they relate to specific crops and, traditionally, provides the insight and ecological knowledge required for making good use of available agricultural resources (Richards 1985, cited in Dialla 1993). Dialla (1993) believes that the Mossi farmers classify soils in terms of cropping potential. The indigenous soil taxonomy may serve as a complementary tool to scientifically based systems, and a pragmatic soil classification allows Mossi farmers to make appropriate use of their land. Conklin (1954) concluded that plant names are significant to the Hanunoo (Mindoro Island of the Philippines), not only as convenient labels for recognized plant segregates but also for the semantic associations of the names employed. The application of traditional knowledge could substantially increase previous scientific information related to flora, fauna, and land use. The Hanunoo could identify approximately 1,600 different varieties of plants where systematic botanical survey had recorded only 1,200 species (Conklin 1957). This difference reflects the fact that the Hanunoo taxonomy employs different principles from those followed in Linnaeus' classification, grouping plants according to life form rather than in terms of genetic relationships (Rambo 1984). Similarly, Dai in Xishuangbanna divided a bamboo species (*Dendrocalamus membranaceus* Munro) into two types soft and hard types according to culm texture.

Conservation.– Indigenous knowledge or practices and indigenous communities have played a significant role for in situ conservation of bamboo resources. Home gardens, bamboo gardens and swidden cultivation systems demonstrate important conservation practices. In addition, recognition of the rights of local communities is a very important step in achieving the reasonable use, efficient conservation, and sustainable management of bamboo resources.

RECOMMENDATIONS

The following recommendations are made for future research and development.

Survey.– More interviews with indigenous communities and field surveys in other remote areas of China are necessary not only for species classification, identification and distribution of bamboo, but also to understand the cultural knowledge and uses of this important resource.

Conservation.– Plans and programs on the conservation of natural resource and cultural diversity should be prepared on a national scale, but with specific recommendation for each tribal group. Development plans should emphasize efficient conservation and sustainable exploitation of bamboo resources. The involvement and cooperation of different levels of beneficiaries is also necessary.

Dissemination of technology.– Some modern management methods and technologies can improve the efficiency of resource use, increase income to indigenous communities, and promote the improvement of well being in these communities.

It is therefore imperative to establish new systems that will link indigenous knowledge and modern technologies for more sustainable resource development. For example, improved/modern methods of bamboo propagation (e.g. culm cutting, branch cutting, and attendant silvicultural practices) may be introduced to the communities.

Financial support for in situ and ex situ conservation.– Conservation of bamboo genetic resources is very important for sustainable production in the future, but may be difficult due to the complexity of implementation strategies that may be affected by the diversity of resources, cultures, and financial incentives.

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